Royal Society of Biology

21st BioChallenges

BIOCHEMICAL SOCIETY

DNA AND **EPIGENETICS**

BIOLOGY FACT

Research suggests epigenetics may be a key factor in brain diseases, like schizophrenia and autism.

www.brainfacts.org

Hidden away inside our cells, genes are the set of instructions that tell our bodies what to do – from physical traits such as eye colour and height, to how big our kidneys are and how our brain works. Genes contain instructions for everything in our body. We've got thousands of them.

For years, it was thought that our genes were fixed from birth; half from mum, half from dad, and that's the way they'd stay.

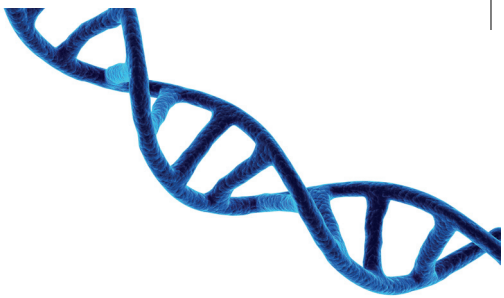
But scientists have discovered it's not that simple: the way we act can influence how our genes function.

MEET THE SCIENTIST

Professor Rebecca Oakey is a biomedical scientist. Her research uses molecular biology to understand how epigenetic mechanisms work normally, how diseases happen when things go wrong, and how they can be treated. Rebecca says: "I work with a team of molecular biologists, clinicians and bioinformaticians to work out how epigenetic factors look after the genome and direct our genes during our early development and afterwards in adult life."

Bioinformatics is a good tool for making the best of the large amounts of valuable information deposited in the databases from scientists around the world. This information can be tested in the laboratory and the results fed back to help solve biological and clinical problems and lead to better drug development."

21st Century BioChallenges is a free resource exploring current issues in biochemistry; more factsheets and related activities are available at www.rsb.org.uk/biochallenges



DNA AND **EPIGENETICS**

The genetic script

At any moment, some of our genes are ‘on’ and some are ‘off’. Just like a film director interprets a script, we each interpret our genes in different ways. When a gene is ‘on’ in one person, it may be ‘off’ in another. This variety is called epigenetics. Chemical reactions label your genes as either ‘on’ or ‘off’ and this changes over time. This creates a pattern of gene activity unique to you.

Why aren’t genes always on?

Imagine a set of traffic lights. When one is green, the other is red. This allows both lines of traffic to go, but at different times. If the lights were always green, there’d probably be a crash. In the same way, labelling genes controls which are active and when. If, for example, the growth genes were always on, we could be 10 feet tall. Labelling genes controls their activity.

Our lifestyles

Scientists have discovered that what you eat, or whether you exercise or smoke can change your gene activity pattern. Over time, these things can alter which genes are labelled ‘on’ and ‘off’. Sometimes this can cause disease.

Patterns through time

Lifestyle changes don’t just affect your gene activity. You’ve inherited some changed labels from your ancestors, and changes that happen in your life can be passed down to your children, and so on. For example, scientists studying a group of people living through a famine learnt that the babies of underfed women were less likely to become overweight in later life.

Scientists have also shown that children of smokers may be more likely to get smoking-related illnesses even if they never smoke themselves.

In other words, parents’ lifestyles can affect how their babies’ genes are labelled. Understanding how and why can help us make healthier life choices for generations to come.

Using epigenetics

Scientists around the world are building databases of gene label patterns that crop up in people with cancer and other diseases. Doctors are starting to check patients against these databases, to identify disease early, when it’s most treatable.

Understanding how gene activity patterns vary between people is helping scientists to make healthcare more personal. Some medicines work in one group of people but not in others and some people really suffer from medicine side effects.

Scientists want to use our unique gene activity patterns to understand why we react differently to medicines, and decide what treatments would suit us best if we got ill.